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KRDB Research Centre Technical Report:

Co-Design with children: the State of the Art

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Abstract
This report is an overview on co-design in an instructional context with intergenerational teams of adults and children aged 7–11 year old. Adults and children become design partners in the design development process of new technology. I will start by introducing the main ideas of co-design. Then I will focus on the user research methods used in co-design sessions. For describing them concretely, I will conclude my presentation by reporting on existing projects that have used these methods in their experiments.

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1 Introduction

Co-design, an updated term for participatory design, is an approach to design attempting to actively involve all stakeholders in the design process in order to help ensure the product designed meets their needs and is usable. Sanders [1] highlights that traditional design methods mainly use observational research, focusing on what people do, while traditional market research primarily considers what people say and think, through surveys, questionnaires or interviews. He has identified mental models in the conduct of the project processes, one is the participatory. The participatory mental model [14] describes a culture that seeks to develop solutions with the persons. In this mental model, designers see people as project partners, since they are the true experts of everyday life experience. Here, the role of people is to collaborate in the creation of solutions, and they are seen as co-creators. The role of the designer is, therefore, to facilitate the involvement of people in this process of creation.

Today, the field of participatory design has grown to become a valued and common design methodology in the development of new computer systems. There is no single way of doing design sessions with users but there are numerous methods and activities which can be carried out in all stages of the software development lifecycle. The methods used depend on the design purpose and on the specific context in which the designer will adapt the methods and techniques. Contributions from users to the design are critically needed when the users are youngsters, as they differ in cognitive development and communities of practice from adults who typically are the designers and builders of the same products that children will use. New tools and techniques need to be developed in order to support the inclusion of children and adults in the design of new childrens technologies as part of a real team with real budget and time constraints[2][3].

This report describes the design sessions that used different methods and techniques reported on several papers that refer to specific projects in which the users involved in the design development process are children from 6 to 12 years old.

2 The role of the children in the design process

The gift more important of a children is his or her creativity. Additionally the children have unconventional viewpoints on all even the most complicated matters and are always ready to share their thoughts. Today's young peoples and the new generation are more skilled about technologies and because have differing abilities to express their ideas and to follow structured tasks, the methods for collecting information and generating solutions should be sensitive to their skills. They are interactive, information active, socially aware and highly mobile; children are natural partners for co-design. In this paper we would introduce the co-design methods that involve children in a deign process. By Druins paper[2], The Role of Children in the Design of New Technology,, we can assert that users can be engaged with different roles in the development process. In particular the roles of children in the creative process can be as users, testers, informant and design partners (see Figure**??**).

At different stages in a product development cycle, co-designing with children may include some combination of all of these roles. We focuses mainly on including children in the design process as informants and design partners. It is critical to support children in the design process because adults do not experience the world as children do and do not have the same insights into the world as a child. In the roles of informant the child plays some part in informing the design process. Before any technology is developed, the child may be observed with existing technologies, or they may be asked for input on paper sketches. Once the technology is developed, the child may again offer input and feedback. With this role, the child plays a part in the design process at various stages, based on when researchers believe they can be informed by children.

In the role of design partner, the children are involved in creating design solutions and could guide the design decisions and evaluate intermediate results. The child is an equal stakeholder in the design of new technologies and when they have this role, the experimenters collect data and initiate ideas of children by means of observations, debriefing and other activities that we will see later on.

We found, as children accept their role as design partners, they better understand their role in evaluating and redesigning computer-related technologies. In a co-design session all design partners (as children as adults) establish common goals and participate in collaborative development activities.

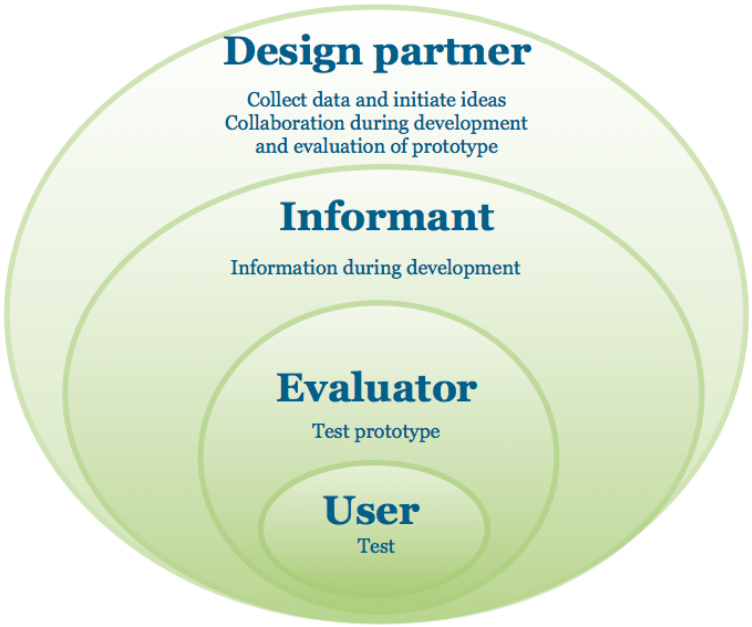

Figure 2.1: Druin's roles

3 Preview on co-design with children

To learn how to do co-design with children, we must first understand what co-designing in a product development context means. Co-Design is an updated term for Participatory design and derives from the work of Sanders [1] on participatory design and co-creation. Sanders defines co-design as collective creativity as it is applied across the whole span of a design process and has developed many different tools and methods to enable co-design in different product development settings. Adopting the participatory approach is commonly considered to have three main benefits: 1) better understanding of requirements, 2) building realistic expectations in target groups and 3) empowerment of marginalised groups [4]. The key and the goal of the co-design session is a collaboration between children and adults and create designing together a prototype of a common idea. Also, Senders defines co-design as not the end of the process but it provides invaluable insight and hence we can use co-design session in our development process in each phase of this process starting from collection of the requirements and ending by the evaluation of the product. Next, ill focus only on the design and prototype phase.

3.1 Research methods

Several co-design methods can be used with children at different stages of the product design process. The appropriate methods may vary depending on the purpose of the research. In this section i focus on methods for on-site research that involve the children directly in the environment where the product would be used and requires use of toolkit and stimuli that spurs creative thinking of the children.

3.2 Generative methods: co-design typical tool

When we begin research work, we should have a set of tools and words acceptable and understandable for the particular age group we are dealing with. Discovering emotions, ideas desires and ideal situations is a crucial part of user research during the early stages of the design process and usually requires generative research methods.

There are numerous ways of doing generative research and a set of methods and techniques how to make their participation interesting and enjoyable; each of which presents different challenges when working with children, as follows:

- Collages: you can get children to create collages by choosing images from a large set of visual stimuli and this activity elicit discussion of the intangiblefeelings and emotions.

- Context mapping: this method lets us understand what the children's values or likes and how they perceives different aspects of their life or an experience. Variations of this approach include doing context mapping as a game, using specific shapes or colors.

- Storytelling: can help us to understand future experience journeys and ideal processes as stories. There are a numbers of way to do storytelling(e.g. storyboards, simple drawings, image cards, role playing, fantasy games and mixed-materials toolkits).

- Inspiration Cards: future scenarios and personas can be co-designed in the form of stories with the use of inspiration cards. These are sets of cards that can be made by the design and research team or purchased as a predefined deck. They contain a variety of images, words and / or complete sentences. The participants construct a story with the cards by positioning them on a large a wall in the order they prefer. The cards can be divided by themes, such as people, places, vehicles, animals, etc., and should be big enough to be easy to see from a normal distance when posted on a wall.

- Modeling: modeling includes physical mock-ups of tangible products or experience journeys. Tools for modeling include collections of 3D shapes in a variety of different materials (e.g., Liz Sanders velcro modeling kits [1]), construction kits (e.g. LEGO).

- Paper protoyping and sketching: paper prototypes or sketches of wireframes can serve as the main elements for co-design activity. These can be printed on large sheets of paper with enough space to draw or comment on. A whole interface can also be broken down in pieces of paper to let users build their ideal interface out of these initial parts.

3.3 Formative methods: conceptualization product

As the design process progresses, the user research methods used should evolve from generative methods to formative methods. This means that the children are involved in shaping and refining the initial ideas for a product, as well as concepts that have started to take a more tangible form. The following are some methods clustered in classical methods (the most frequent methods used for co-design with children)and the expanded methods (methods that start form the classical methods and expand their features and use in several context using different tools and environments),that can be use during the conceptualization phases of a design process. We classified formative methods into state-of-art methods and recent innovative methods for co-design.

3.3.1 State of the art methods

The most used formative methods is the cooperative inquiry and in this Druin. Alison Druin and her team at The University of Maryland developed this method[3]. It combines

more traditional user research methods, including contextual inquiry and participatory design, with what she refers to as technology immersion, within the context of conducting research with children. The following are some methods that you can use during the conceptualization phases of a design process.

Cooperative inquiry

Researchers at the University of Maryland pioneered the design process of Cooperative Inquiry[3]. The techniques of Cooperative Inquiry enable children and adults to work together to create innovative technology for children. These methods include ideas adapted from cooperative design, participatory design, and contextual inquiry, but are tailored to meet the unique challenges of working with children. Druin identifies three main techniques comprised in the cooperative inquiry method: collect data about the users environment (contextual inquiry); to use low-tech prototyping to represent their design ideas (low tech prototyping and mockups); and to explore different technologies to include in the design (Technology immersion).

1. Contextual inquiry This activities is doing in order to observe what children do with what technologies they currently have. So the design team conducts one-on-one field interviews with users in their workplace to discover what matters in the work but these are not traditional question and answer interviews: both adults and children observe, take notes, and interact with child users. The interviewer and user, through discussion, develop a shared interpretation of the work. It is like an active inquiry into the user's world. This inquiry, done in context, is where Contextual Inquiry gets its name.

2. Low-tech prototyping and mockups Low-tech prototyping tools (e.g., paper, crayons, clay, string, LEGO bricks) provide material to sketch ideas. Researcher journals for children and adults serve as a repository for ideas and research evaluation. These journals may be used to sketch design ideas, collect photos of technology artifacts or reflect on team activities. Depending on the age, discipline, or note-taking style of the researchers, different methods of describing or capturing their thoughts can be used (e.g., drawings, photos).

3. Technology immersion

   This process is used to introduce children to the capabilities and possibilities of a particular technology and was created to understand how children use large amounts of technology over a concentrated period of time and how a particular technology may fit children's need and abilities. Many children still have minimal access to technology in their homes or school; with technology immersion, it is critical that children not only have access to technology in a concentrated way, but are also decision-makers about what they do in that environment. Children must be asked to make their choices when using different kinds of technology.

Variants of cooperative inquiry Starting from the cooperative inquiry methods, variants of this technique include the following:

- **Mixing ideas**[5]: this approach aims to involve younger children in a design brainstorming process by encouraging each child to generate ideas and combine them with the ideas of others in a group. In the first step the children were coming up with individual ideas that they considered their own; each child worked with an adult to watch their classmates center activities. The children then drew what they observed in their research journals, and the adults annotated what the children were observing. After each child had individual ideas , the next step was to mix their ideas on table-size pieces of paper using magic markers and open their journals each child go over their ideas to share it with others. The final step of this process involves combining all of the pieces of ideas that a group has generated to create one big idea that provides a final, more structured direction for continued exploration as part of a design and development process. [5]?

- **Sticky-note frequency analysis**: you can use this method to evaluate a technology product or prototype with both children and adults. Each member of a group evaluates a product or prototype by writing what they like or dislike about using it on sticky notes, then placing the notes on a wall, where the researchers uses affinity diagramming to find patterns and trends. [6]?

- **Layered elaboration**: this method aim to generate ideas through an iterative co-design process. This technique supports asynchronous co-design and at the same time enables creative expression of the children. With this approach, participants start developing an idea designing on a transparency applied over a piece of paper during the first sessions and continue building upon this initial work in successive workshops; so each design group is enables to understand the current design and add to their new design. It is a good methods because several designers can contribute ideas in a non destructive way. [7]

3.3.2 Expanded and Innovative methods

In this session we, starting from the methods mentioned before, introduce some of expanded and innovative methods implemented and descripted in the Chapter 4. This includes use of physical objects and social interaction; often, if there are children with special needs, the methods get adapted and contextualized, as follows.

- **Expanded layered elaboration [8]**
  To address the needs of a geographical distributed co-design audience, the authors designed and implemented a prototype web-based software package to facilitate Layered Elaboration. The distributed co-design tool, DisCo[8], was designed to expand Layered Elaboration from a paper-based technique to an on-line environment that allows co-designers to work asynchronously and manages iterations of designs. Layered elaboration was chosen as the base technique because it is asynchronous in its execution since only one design group works on one design problem at a

time. DisCo breaks down power roles in accordance with cooperative inquiry and encourages creative expression without fear of permanently destroying something(see Paragraph 4.3).

- **Making tool[9]**
  Make tools, introduced by Sanders [9], is one of the methods developed to amplify peoples creativity and support their ideation in co-design. The basic idea is to allow people to construct design representations through visual elements as expression of need. The make tool kit consist of various shapes of blocks covered with fabric suitable for use with Velcro which can be easily attached and detached. Those blocks can represent forms, buttons or displays and can be easily reconfigured into new combinations by potential users. Make tools provided an engaging stage for building the designs and using this make tool kit the participant can realize their ideas into a tangible prototype (see Paragraph 4.4).

- **Embodied narratives [10]**
  Embodied Narratives (EN) is an exploratory co-design technique for early stages of the design process. This technique stimulates dialogue and conversation through embodied interaction, promotes open and interchangeable roles and does not require plot outline. EN born to expand embodied and performative design techniques and it is called EN because it enables children to build narratives out of the things they perceive and observe performatively.

  The EN is an iterative process composed of events that include: (a) brainstorming, (b) performing, (c) shooting, (d) printing, and (e) sharing (see Figure **??**).

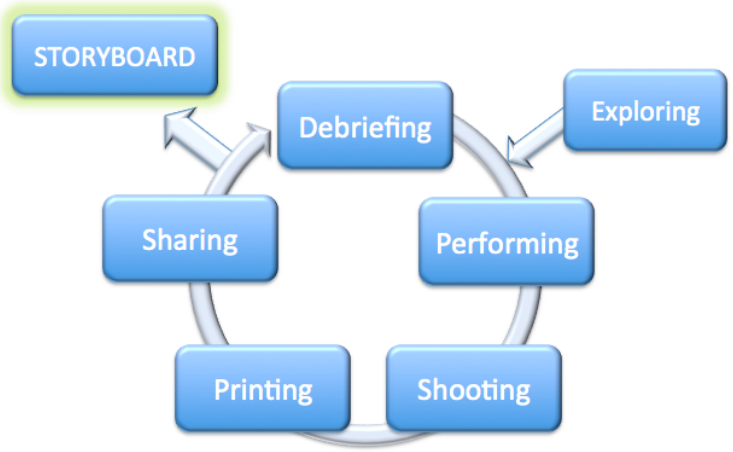

Figure 3.1: Embodied Narratives events iteration cycle

As the starting points the participants have a debriefing in which teams of children discuss upon what to design and to support the idea generation. In this phase

the environments and the objects and peoples that encountered in it was explored. Then a scene is collaboratively set (performing) and captured (shooting) through the digital camera. Once a digital picture has been taken and printed (printing) out in the form of a sticker, children brainstorms (shared) on what to perform next. At this point ideas are generated and performed.

This technique have several advantages as increase freedom for children to dialogue and express their perceptions and facilitate rapid and iterative co-creative events. Moreover, the ability to print and share pictures instantly gives children immediate gratification, boosting childrens playful explorations.

4 Co-design Projects

In this chapter i will refer to the research findings and to existing projects that have used the method mentioned above in their experiments. This authors use co-design session in their product development process and involve children mostly from 7 to 11 years old in their design session.

4.1 WII can do it: using co-design for creating an instructional game [11]

This paper presents the methodologies and results from co-design session with children from 7 to 11 years old. The experiment involve the use of the Nintendo Wii that with its motion-controlled sensors, can support learning experiences that enable children to be physically active learners in the design process. The goal of this experiments was to design an instructional game that leveraged the Nintendo Wii's motion controls to teach about U.S. National Parks.

Users and methods The users involved are a group of 9 children from 7 to 11 years old; in the group there are 2 children (one boy and one girl) that have been labeled as having challenges with attention and focus. The chosen methods was the cooperative inquiry and in order to create high-tech prototype, adult and children working together in the design process and redesigned iteratively the low-tech prototypes.

Working sessions The working session consist of three design sessions, made in 3 different days, placed at the University of Marylands Human-Computer Interaction Lab.

1. The participants, divided into pairs, in 10 minutes took turns playing Wii Sports to became familiar with the console (chose their avatar, play to WII sport Tennis game and use the wii controller). When not playing with the Wii, the participants wrote in their journals about their favorite video games.

2. The participants, grouped into 3 team (3 children and on adult for team), were asked to design their own instructional video games using low-tech prototyping techniques; they received a bugs of stuff (e.g. construction paper, beads, glue). The game they had to create would teach someone about something related to the U.S. National Parks or some historical events. At the end of this design session, the participants met to discuss each others ideas and Big Ideas - common trends in participants ideas - were identified.

3. The participants, in their previous session team, used Mixing Ideas as the main method of design. Each team worked on combining their ideas into one cohesive idea that would be presented to the larger group. At the end, the common trends were identified and the group began to come up with one design for an instructional video game.

Findings From the first play session, several children revealed some difficulties in using the Wii controller as a mouse and were very interested in the avatars as well and enjoyed choosing avatars; some participants mentioned that they wanted more realistic avatars. The journal session, after the children played, was conducted rapidly in order to return soon to play.

From the second session, the most common trend was the idea of time travel to historic events; for the children playing with a character, created by themselves, in a time travel was a good way to learn about history and social studies issues.

From the third session, the group agreed that the game would have the following attributes: avatars, time travel with a time machine, missions to complete in historical times, reward system, use of motion controllers in an analogous way.

4.2 Layered Elaboration:A New Technique for Co-Design with Children[7]

This paper reports on a co-design technique named Layered Elaboration" that involve children from 7 to 11 years old. The goal of this experiments was to design a game about history and a prototype of an instructional game about energy conservation that enable children to learn about green approach to life.

Users and methods The users involved in the experiments are children from 7 to 11 years old. The chosen methods was the layered elaboration with which the children grouped in team with adult, as design partners, met at one time to gather ideas and input on the storyboards drawing on a piece of cardboard with transparent overlay on top.

Working sessions The design team consists of one adults and three children. Adult reads a description of the current storyboard and then asks for how it can be improved. The children, drawing with their specific color, take turns talking and adding new ideas to the transparency. In total there was 3 session of about 15 minutes each one. Once the group thinks the storyboard is complete, the transparency is removed and a new group follows the same approach to give their ideas without permanently destroying it. At the end of each storyboard each group had an interim debriefing and got together in the middle of the room for a stand-up meeting showing to the other groups their ideas and individuating the common trend. After each debriefing sessions, once a group presented, a transparent overlay with registration points was added. At the end of all design sessions, all ideas from the design partners were identified and written on the

white board in order to develop a prototype game. The game developed was named "Energy House" and consisted of a virtual house with electric devices.

Findings The first advantages of this technique is the cost of the materials that it is low and its portability because does not require much space or multiple resources. Other advantages is the ability to add to and modify the initial storyboard without permanently damaging or altering it and each design team can immediately see the similarities and differences of each group's modifications . Also, this technique is relatively rapid because allows a number of design partners to provide input and ideas in a short amount of time. As Disadvantage, the researchers observe that some design team members did not pay attention to the other groups when they presented in the stand-up meetings, which led to confusion and less elaboration.

4.3 DisCo: a co-design online tool for asynchronous distributed child and adult design partners[8]

This paper reports on the prototype design process of the tool named DisCo, a computer-based design tool that enables intergenerational co-designers, adult and children, to collaborate online and asynchronously while being geographically distributed. The goal of this paper is to answer the question: "What does a computer-based design tool require to facilitate distributed co- design with children?"

Users and methods The participants involved in this experiment was 20 children, between the ages of 7 and 11 years old, and 12 adult. The experiments was spanned into 3 main session made in different period: spring 2010, summer 2010-spring 2011, and summer 2011.

The methods choose was the Cooperative Inquiry and a different use of Layer elaboration with which the authors expand the Layered Elaboration from a paper-based technique to an on-line environment that allows co-designers to work asynchronously and manages iterations of designs.

Working sessions Through iterative co-design, a computer-based design tool has been developed. This tool facilitates distributed co-design with children based upon Layered Elaboration.

In total to the children were presented 5 version of the prototype and for each version there was a different session that include observations, group discussions and co-design sessions. In total did 2 experiment. In the first experiment the children use the first three versions of prototype and was executed in a lab comprised of two rooms with eight or more computers in each room; each child-member was paired with an adult and was assigned a computer, a team name and one of the topics for each team. They were then given ten minutes to create a design about the assigned topic. The co-design team, for each working session, worked on the prototype and from their observation and comments the authors were able to modify the previous version of the prototype adding new features

and new items. The second experiments requires use of the last two prototype and the tool was used as a part of an online environment to foster geographically distributed co-design and was used in the design of several different technologies. The participants were at home or on vacation when accessing DisCo and this version included an avatar in the comments section that the designers could upload through a profile tool.

The second experiment was executed to foster the geographically distributed co-design and the children could access to the tool from their home during their vacations.

1. First version of the prototype. The screen is divided into three parts: a canvas for drawing, a box for annotating the design and a comments pane that displays the designers' annotations for their respective layer to facilitate elaboration (see Figure **??**). The group initially sat in a circle to discuss what the group was going to be doing that session; later the design session facilitators explained that the design teams would be designing, using the computer, a mobile user interfaces for doing homework, hanging out with friends, doing classwork, going on vacation, and watching television. The design session was divided into 3 round session of 10 minutes each one. Each team was assigned a topic to design in ten minutes and after that ten minutes all the designers were asked to stop designing, a researcher walked around and gave each group the next topic to design in the next ten more minutes. For their final round of design, each group was given their next topic and was asked to use sticky notes to provide design ideas on the DisCo tools. After the three design sessions, the group have their "Big Ideas" session and discuss the main ideas for the tool that were collected on the white board.

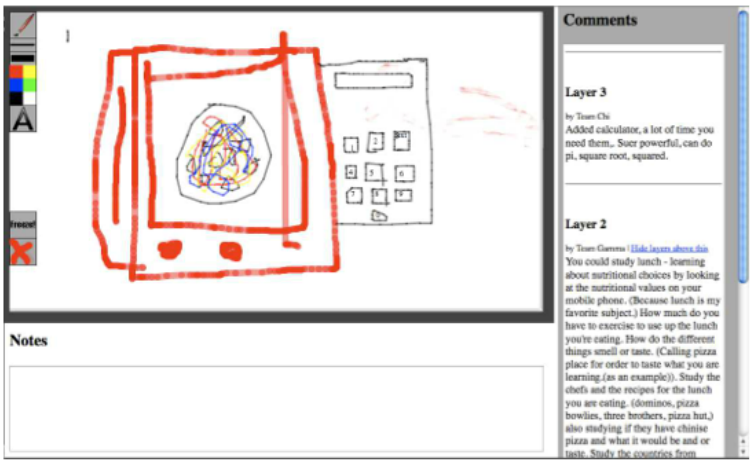

Figure 4.1: First Prototype of the Disco tool

Second version of the prototype. In order to incorporate the design ideas generated and the shortcomings observed in the first iteration, modifications were made to the prototype(e.g. undo function) . In this session was asked the children to come up with

a problem that could be solved with technology and use DisCo to design the solution. They wanted to create a diverse array of problem-solving devices: a device that helps you learn to draw, a device that automatically does your hair, a device that helps you not be hungry in class, a device that helps prevent bullying etc. Therefore adult and children had a debriefing in which discuss on their ideas and about the changing effectuated to the prototype.

Third version of the prototype. This session involve participants in the design process of a game that teaches financial literacy to children and in a similar way to previous design sessions was asked to design a computer game based on the board game, redesign the board game, create a mobile game and design a character builder for a financial literacy role playing game.

Fourth and fifth version of the prototype.

Using the fourth and fifth version of DisCo, the intergenerational design team was able to design a computer game whose goal is to teach young children how to read (See **??**disco5.png). The children in this case could use an avatar that represent themself and the game was designed to mimic a board game and involves a penguin that must get back to her igloo by choosing the correct picture that corresponds to the word displayed on the screen. The team envisioned that the game would be multiplayer so young children and parents or caregivers could play along.

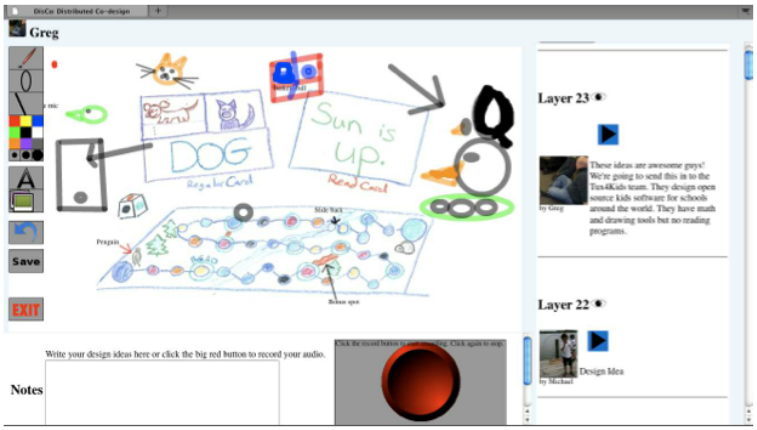

Figure 4.2: Fifth Prototype of the Disco tool

Findings The first prototype was the authors attempt to solve the initial problem of distributed co-design. Children had higher expectations of their own ability to draw with a computer-based design tool than of paper-based techniques (e.g. they were frustrated when they weren't able to draw straight lines), this expectation was realized adding design features in the next version of the prototype, such as more detailed drawing tools.

Several time, children mentioned that they wanted to draw with their finger on a touch

screen device. Participant designers who know each other seem to make a good-faith effort to add to a design.

Distributed co-design on the computer requires an extra level of facilitation that is often taken for granted in co-located sessions.

4.4 It has to be a group work! - Co-design with Children[12]

This paper describe two design experiments that involve children aged 7 to 9 years old, to explore the applications of co-design methods with children. In those experiments, the participants are capable of utilizing make tools but have challenges in group dynamics and reflecting everyday experiences into design ideas.

Users and methods The two experiment were conducted with 23 children aged 7 to 8 years from one class. The chosen methods was Make Tools, its idea is to enable everyday people to express their latent needs and dreams through reconfigurable mock-ups provided to them.

Working sessions

1. **The first experiment** aim to create an intelligent interactive device that supports learning and collaboration in teams. Referring to the school book, familiar to the children, named Pikkukone in which the children can creates words from letters that are fed into it, the design brief for the children was to design "a cousin of Pikkukone", a learning buddy.The children was grouped in team and use the materials of the Make tools kit to (various sized blocks, ready-cut pieces of cardboard and buttons that have symbols such as question marks, snowflakes and words including help or error) started design and building rather robot-like creatures with imaginative functionalities such as "a spelling corrector . At the end of the experiment the designs were introduced and their functionalities were explained to all.

2. **The second experiment** The goal for this second experiment was to design a new eco-games . The experiment was executed by 3 steps. In the *first step* the children watch The Simpsons movie in which Lisa convinces the city of Springfield to protect the nature. The aim was to create a framework for following activities, and after the movie we told children that their task is to help Lisa to save the planet. The *second step* was to build scenarios of every day life by playing an eco-game using a make tools kit as in the first experiment. In the eco-game, children were told to throw a dice and move their game pieces on the board turn by turn. The board had faces on it and when a kids game piece stopped on the faces, she was supposed to flip one of cards over. The cards had instructions for the discussions and building scenarios.The cards also had blank bubbles; children could write quotes and create stories based on them. When children finished building the scenarios, they could earn a key to open the make tools box and move on to next step, the make session. In the *last step* (Make Session) children were asked to design a magic tool or a

secret weapon to save the earth by using make tools. After the make session, each group presented their design outcomes to other groups.

Findings We list as follows the findings for the two experiment described above:

For the first experiment, the children had difficulties in group collaboration and in conducting constructive discussions in the co-design process. The childrens abilities are highly dependent on the age and the final solutions were not all based on very constructive negotiations. Children had difficulties in making connections with the discussed activities and the design ideas.

For the second experiment, the game had too many rules and tasks and the children did not clearly understand all the instructions and tasks of the game. The game structure and role playing didn't support children into more open collaboration but the game-like construction did not fully remove the team collaboration challenges identified earlier.

During the game, they mostly sat as they usually do in normal class. However, the situation changed when children were provided with the tangible materials for designing. All group members became more active to better access the materials by being closer to each other in one corner of the table.

4.5 Embodied Narratives:A Performative Co-Design Technique[10]

The paper describe the theoretical and methodological foundations of a new co-design technique called Embodied Narratives and it discusses its strengths and weaknesses by means of empirical studies conducted with 36 children in home and school settings.

The main goal of the EN is to create stories that can help gain a more holistic understanding of human actions and entanglements and to The specific goal of the experiment was to design of a social game meant to help children learn how to respond to emergency situations that can occur at home or at school.

Users and methods The participants involved in the experiment session was 36 children from age 10 to 11 grouped in eight different groups (both unisex and mixed). For each group, the activity lasted about two hours. The method chosen is the Embodied narratives. This tecnique, as described in the chapter , was an iterative process composed of events that include: brainstorming, performing, shooting, printing, and sharing.

Working sessions Two experiments was conducted in two different environments: at home and at school.

At home: the experiment was conducted in the familiar environment of the house of one of the girls parents. The girls were tasked with designing a game that would teach younger children how to avoid domestic accidents or to respond to a dangerous situation in the home when this occurs. It was up to them to identify potential dangers

and perilous situations. The girls split into two smaller, self- selected groups of 4 girls and one adult. Each team was assigned one of the two bedrooms in the house.

A final debriefing, in which children were asked to verbalize their experience and give an explanation for critical events and interactions we observed during the activity, was carried out in the living room.

At school: for the second experiment, they gathered 28 children (11 girls and 17 boys), and split them into six self-selected groups (4 unisex and 2 mixed). The experiment was conducted in two sessions, each session including two groups unisex and one group mixed. Like in the first experiment, the children were tasked with the same problem of creating a game aimed to teach younger children about the risks that can occur in a school environment. Like in the first experiment, children were told that the classroom represented their base but they could use the entire school and its grounds. As a result, like in the first experiment, the actions of each team added to the social setting of the experiment. The final debriefing was carried out in the actual classroom of the children.

Findings Children exhibited different ways of exploring the setting and as a result, their explorations were targeted to identify what dangers could be included in the game they had in mind. The children interact with other children and all children participated actively in the design process by spontaneously assuming and exchanging roles in taking photographs, performing scenarios, and adding pictures and captions to the storyboard. Social relationships between children added meaning to the activity intact for some teams, existing friendship contributed additional fun to the activity. In each session, teams were working separately but in parallel. The children using the instant digital camera were spontaneously drawn to explore the environment. They used the camera to generate ideas for the game, identify potential dangers, and create visual building blocks (i.e., stickers) for the storyboard.

4.6 Co-design with children with special-needs

Actually numerous designers have included children with special needs in technology design processes, and children with a wide range of disabilities have participated in the design process, to varying degrees. Co-Creating technology with children with special needs is always challenging and at the same time the life worlds and lived experiences of children with disabilities are far removed from the experiences of typical designers or researchers; giving children with disabilities a stake in the design of technology gives them a sense of ownership and empowerment. Such inclusion of children with disabilities in the design process of interactive technologies, however, does not come without its risks and challenges. When designing technologies for children with disabilities, the focus is to alleviate the burden of the disability and either provide access or enable children with disabilities to learn or perform actions that would not be possible without the technology. To successfully ground a design it is necessary to consider theories related to the disability, developmental theories from both cognitive and social perspectives, HCI theories and learning theories. When the design process involve children with special need

is better introduce technology as late as possible users are freed from conforming to the existing. The use of tool as pen and paper are more accessible and versatile and low tech prototyping materials must provide a natural means of communication and expression. Similarly, relationships and ethical issues require particular sensitivity to ensure that participants feel values, safe and able to contribute meaningfully to the design process. In this sense, pictures taken by the children were both the performative expression of their perceptions and elements of their design outcomes (e.g., cards, game boxes, game pieces). In this chapter we show an overview of several projects that include in the co-design session children with special needs.

4.6.1 Designing technology for children with special needs: bridging perspectives through participatory design[13]

This article discusses on co-design for involving children typically developed and with special needs in the design of a technologically enhanced learning environments. The goal of the project, named ECHOES, is to create an environment that scaffolds the development of children' social skills. When designing with children with special needs, the difficulties around sharing responsibilities, communication and ethics may increase; therefore is more difficult to develop system for children with disabilities and collaborate with them in the design process. The features of children with special needs required the authors to adapt common method of co-creations and building on existing work in the field of psychology and on theoretical foundations, were defined a succession of learning objectives that aim to improve social skills of children and create a methods and new way to interact with children within the design process.

Users and methods The users involved in the design process are children with typically developing children and children with Asperger's syndrome (AS) or high functioning autism spectrum conditions (HFA).

The approach implemented within the projects ECHOES was participatory design (PD). There was two design group: typically developing children and children with special needs. The focus is on the co-design process and on the interdisciplinary tensions therefore were used non-digital formats, sensory exploration and storytelling in order to bridge tensions between system design and the imaginary worlds and the creative potential of the children's and to facilitate meaningful participation

Working sessions and findings In the experiment participate two group of children: one of 30 typically developed children of 6 years olds and one of 3 children with special needs (two boys with HFA and a girl with undiagnosed social and language difficulties). Four working sessions was arranged with each group, the duration of each sessions was about of one hour.

1. WS 1: The Desert Island In this activity children were involves as informant in order to investigate how they interact with objects; as the starting point for developing the activity the authors posed some questions(e.g. What modal properties of

objects engage children spontaneously?). This activity is inspired by the work of van Rijin and Stappers []and the concept of a toolkit expression. Starting from the Fictional Inquiry technique (Iversen and Dindler, 2008[]) was developed the following plot from which the activity starts:
"Imagine you and your friends are in a desert island, somewhere on the wide open sea. There is enough food around and someone will come and rescue you sometime soon, but it is rather boring there. But then you find this treasure chest, so, what could you do with all that magical stud in the treasure best to keep you and your friends entertained until rescue shows up?". Children were divided into 5 group, each setting around a large table;each group received a toolkit: treasure chest contains around 10 physical objects and children are encouraged to use drawing and writing while developing their ideas (20 minutes). Subsequently, one child from each group was chosen to be a journalist and make interview to other group about their object and games. The next day, each children had to draw their favorite object. As a result, various affordances , especially the distinction between functional and no-functional affordances, were identified and fed into the design and co-design activities.

2. WS 2: The Odd-One-Out This activities was developed to investigate how children interact with objects but within the framework of a given task. Again, at start the authors posed questions to individuate the main goal of the activity (e.g. Does the structure of a task impact on the behavior towards objects?). To investigate the questions posed was chosen the add-one-out task. The children were split into group of 6-7 child and each of which received a set with 3 objects and the worksheet(10 minutes); the task was to circle the odd-one-out and explain by drawing or writing on the worksheet why distinguished the object they chose.

   As a result children from the HFA group focused much more on perceptual affordances and details who[rivedere];the typically developing children used mainly functional affordances (e.g. it bounces)to distinguish between objects.

3. WS 3: The comic The aim of this activity was to probe explicitly for the role of such objects in stories. Again, the questions to answer.(e.g. How can the embedding of given objects into narratives be facilitated?). The work was inspired from Gray who developed social stories and comics for children with ASC; the additional requirement was that they should incorporate a special object (that had previously encountered in the other working session) into their story. The children was split into 5 groups and the narrative framework was: "The princess has been locked up by the nasty dragon, can you hel to free her?The key to her freedom lies in this thing you were given by the great magician. It has special power that you will need to use to free princess and lock up the dragon" Each group received a narrative templates that the children were asked to develop. This templates (as in figure **??**) had some frame blank, apart from the first and the last frames that explained the story and determined the start and end points for the narrative. As a results most of the children give the description of the objects used but did not

incorporate it into the story. In conclusion the group had difficulties using and in contextualization of the objects; also the framework should be more structured and more easy to understand.

Figure 4.3: Worksheet num.3: the comic

4. WS 4: Into the digital This session consist to provide each group of a series of prototypes where the notion of agency was explored.

   The aim of this approach was to explore possibilities within a virtual environment that would not be possible in physical reality. These sessions also provided key parameters for the technical challenges in terms of capturing information about the child in a messy environment and the reliability of the system.

4.6.2 Participatory design with children with autism

The paper report on the COSPATIAL projects (Communication and social participation: collaborative technologies for interaction and learning). The project explores how can develop effective and useful educational technologies in the form of shared active surfaces (SAS) and collaborative virtual environments (CVEs) and aim to support the enhancement of social skills for children on the autism spectrum. The prototype, developed for a collaborative design, was a serious game named the Block Party that involves the children

building a tower together in the virtual environment. Each block is divided down the centre into two colours and child has a different target colour pattern that they have to achieve. In order to complete the task they therefore need to communicate with each other in order to jointly select a block with the colour combination that suits both of their needs.

Users and methods In total six typically developed children from 10 to 11 years old and five children with ASC of 16-17 years old was involved in the experiment. The method used was a cooperative inquiry with several session that include contextual inquiry, technology immersions and other activities. For the children with ASC the working sessions were adapted for their disabilities. The autistic children have different problems as limited language or communication skills, learning difficulties and poor imaginative skills.

Working sessions and findings Six Primary School children (2 x 10 year olds, 4 x 11 year olds) took part in a 3-hour design workshop. The first task Worksheet 1 was to discuss in groups the computer games they use at home and what they like about them. The discussion then moved on to Worksheet 2 and focused on what makes a good game. In the worksheet 3 the children have to design a new game and detailed aspects of the game such as the name, number of players and the rules. The students then went on to draw their game ideas on to large sheets of blank paper. With the ASC children, the Block Party training scenario was projected via the interactive whiteboard in the classroom so that the whole group could see it. A keyboard and a mouse were connected to the laptop with an extension cable so that all students could have a turn to interact with the CVE from their seats. Each student was provided a feedback sheet that contained screenshots of various stages of the Block Party activity alongside columns that were headed Like, Dislike and Not sure. Feedback posters were placed on the wall next to the whiteboard. The other activities was given to the autistic children in other form (e.g. mindmap) because children with ASC are often visual thinker and a pre-prepared template was used to help the student understand what was expected of them.

In brief, this method is considered a success for a number of reasons including the depth of understanding of the task at hand, the quality of ideas generated by the students and the length of time spent on-task. However, issues such as the use of personas, the length of the activity and the large design-decision space presented need further consideration.

4.6.3 Involving blind children in the co-design of a Wii game

This article talk about the co-design approach used with children with visual disabilities and how this methods were adapted to involve blind children. The initial goal was to develop a serious game which helped children to improve their balance and body orientation but after a debriefing with the blind children, the researcher discover that they would a game designed in a way that they can compete with sighted children on an equal basic. Therefore the final goal of the project was to design a game which can be

played both by blind and sighted children, using the WII console and the Balance Board that involve the participants to move their body.

Users and methods In this experiment was involved 4 families with blind and sighted children and in total 9 children from 6 to 12 years old participate in the co-creation session. The methods used was a mixing of cooperative inquiry with specific co-design tools (e.g. mindmaps)

Working sessions and findings The working session consist of 3 main steps.

1. Step 1: Creating a shared understanding The children were asked at home, during their holidays, to fill a mind map (with Braille codes for blind children) with the game they liked to play and why. The second session consist of a group session in which the children decide on the game characteristics selecting them from that collected from their mindmaps. For this task was designed a card training game within each card had one game item on it, in writing and in Braille. The children were told to go to the other children to find out their cards and trade cards with other until they found their 4 preferred game characteristics. (e.g. adventures and finding out how to continue; begin smart.)

2. Step 2: Creation of a game concept The children need to experience playing with Wii at home, therefore during 2 weeks they played several games and were asked to keep a journal in which write their observations as like, dislike, problems and so on. After this, in the design session the children are grouped in mixed team: one team with the youngest and one with the older. They were asked to discuss and decide the type of game they would play. In this session the adult as facilitators help the children too remain focused and asked them create solutions for the blind children. After this session was doing a more individual session with small group of one blind and one sighted children.

3. Step 3: Prototype evaluation Several versions of the working prototype on the Wii were tested and evaluated by all the children individually. The first prototypes were very basic and had very little game elements implemented; at the end the last prototype have all the audio and tactile elements implemented and some basic mini-challenges. When the final prototype was developed, the game was evaluated by the previously involved children and also with a new, unbiased group of blind children. The game takes place in old Egyptian maze-like, dungeon from which the game character (named Ben) escapes after solving several levels. The goal of the game is to collect treasures which are hidden under the tiles of the dungeon (so they are not visible to sighted children). An Egyptian princess helps Ben in the game with instructions. The player navigates through the dungeon by leaning forward, sideways or backward on the Wii Balance Board. Tactile feedback is given through the Wii-remote if the character hits a wall. To find the location of the treasure, there was a special device that makes sonar like sounds. When all the treasures are found, the child can move to the next level.

5 Conclusion and future work

Co-design is working with people, giving them some tools and getting their view of what they would a product or service to be. It's not the end of the process but it provides invaluable insight [1]. Co-design emphasizes the collaborative aspects, involving the client/user as equal partners, especially in their role as "domain experts" in the area of what's wrong with the way things are. When people are invited to make an opinion, it does not necessarily means that is taken into account, and the level of influence is relatively low; when people are asked to participate, interact and collaborate in the building of a design process, then there is a high level of influence. The sentence is not 'you help me', rather than 'we collaborate each other'(Pablo Caldern). In conclusion, from our surveys we can assert that:

- co-design is a quick efficient way of uncovering insights which may have been more difficult to get at using other means, it's fun, and it helps with engagement and adoption of new designs; therefore is a good way to develop a final product that meets the requirements of specific users.
- use of new device as tablet, shared surface or WII controller, make the activity more enjoyable and fun for the participants that will produce much more ideas.
- using avatar and set their roles and features are more important for the children because most children place themselves in the characters and may prefer a game for that reason;
- working together with the same goal for the children seem to be a good way to increase their inclusion into a group and increase their collaboration intra group and with the adults. Moreover avatars are also used to increase motivation of the players as pedagogical agents when they play computer games;
- children are motivated and enthusiastic on using physical objects and create tangible prototypes;
- use of co-design first of all facilitate the work of the designer and using children as co-design partner allow us to reach significantly positive result when we develop our products. It is exemplified that there are sure benefits of being meaningfully engaged with co-designers from the beginning a project, to its final manifestation.

6 References

[1] Sanders, E., and P. Stappers. Co-creation and the New Landscapes of Design.In CoDesign: International Journal of CoCreation in Design and the Arts,Taylor and Francis: 2008.

[2] A. Druin. The role of children in the design of new technology.In Behaviour and Information Technology, 21(1):1–25, 2002.

[3] A. Druin. Cooperative inquiry: developing new technologies for children with children.In Proceedings of the SIGCHI conference on Human factors in computing systems: the CHI is the limit, p.592-599, May 15-20,1999, Pittsburgh, Pennsylvania, United State[doi¿10.1145/302979.303166]

[4] P. Ehn. Work-oriented design of computer artifacts.In Arbetslivscentrum, Stockholm, Sweden, 2nd edition, 1989.

[5] Mona Leigh Guha , Allison Druin , Gene Chipman , Jerry Alan Fails , Sante Simms , Allison Farber, Mixing ideas: a new technique for working with young children as design partners, Proceedings of the 2004 conference on Interaction design and children: building a community, p.35-42, June 01-03, 2004, Maryland.

[6] A. Druin.Children as Co-designers of New Technologies: Valuing the Imagination to Transform What Is Possible.In New Directions in Youth Development: Theory, Practice, and Research: Youth as Media Creators. Retrieved March 31, 2012.

[7] G. Walsh, A. Druin, M.L. Guha, B. Foss, E. Golub, L. Hatley, B.Bonsignore and S. Franckel. Layered Elaboration: A New Technique for Co-Design with Children.In Proceedings of ACM CHI 2010, Atlanta, GA, 2010. Retrieved March 31, 2012.

[8] G. Walsh,A. Druin, M.L. Guha,E. Bonsignore, E. Foss, J. Yip. DisCo: a co-design online tool for asynchronous distributed child and adult design partners.(2012) IDC '12 Proceedings of the 11th International Conference on Interaction Design and Childre Pages 11-19

[9] Sanders, B.-N., and Pieter Jan Stappers. 2008. Co-creation and the new landscapes of design.In CoDesign 4(1): 5-18.

[10] Elisa Giaccardi, Pedro Paredes, Paloma Daz, Diego Alvarado. Embodied Narratives: A Performative Co-Design Technique.

[11] G. Walsh. Wii Can Do It: Using co-design for creating an instructional game. CHI EA '09 CHI '09 Extended Abstracts on Human Factors in Computing Systems Pages 4693-4698

[12] Kirsikka Vaajakallio, Jung-Joo Lee, Tuuli Mattelmki: "It has to be a group work!": co-design with children. IDC 2009: 246-249

[13] Frauenberger, Christopher, Good, Judith and Keay-Bright, Wendy (2011) Designing Technology for Children with Special Needs - Bridging Perspectives through Participatory Design. CoDesign, 7 (1). pp. 1-28. ISSN 1571-0882

[14] Elizabeth Sanders. An evolving map of design practice and design research. In Interactions, 2008.